AX5400PA/PB

16 Ch. Isolated Digital Output Card with PCI Bus

User's Manual

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ESD Precautions

Integrated circuits on computer boards are sensitive to static electricity. To avoid damaging chips from electrostatic discharge, observe the following precautions:

- Do not remove boards or integrated circuits from their anti-static packaging until you are ready to install them.
- Before handling a board or integrated circuit, touch an unpainted portion of the system unit chassis for a few seconds. This helps to discharge any static electricity on your body.
- Wear a wrist-grounding strap, available from most electronic component stores, when handling boards and components.

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Unpacking

The AX5400PA/PB is packed in an anti-static bag. The board has components that are easily damaged by static electricity. Do not remove the anti-static wrapping until proper precautions have been taken. Safety instructions in front of this User's Manual describe anti-static precautions and procedures.

After unpacking the board, place it on a raised surface and carefully inspect the board for any damage that might have occurred during shipment. Ground the board and exercise extreme care to prevent damage to the board from static electricity.

Integrated circuits will sometimes come out of their sockets during shipment. Examine all integrated circuits, particularly the BIOS, processor and keyboard controller chip to ensure that they are firmly seated.

After unpacking the AX5400PA/PB, check and see if the following items are included and in good condition. If any of the items is missing or damaged, notify your dealer immediately.

- AX5400PA/PB Board
- AS59099 DAC Driver CD
- Cable 50P 31cm
- AX5400PA/PB User's Manual
- Warranty Card

Make sure that all of the items listed above are present.

What To Do If There Is A Problem

If there are damaged or missing parts, contact your supplier and/or dealer immediately. Do not attempt to apply power to the board if there is damage to any of its components.

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Chapter 1
Introduction

The AX5400PA/PB is a 16-channel opto-isolated digital output card with PCI interface. It plugs directly into any 32/-bit PCI bus and provides either 16-channel electromechanical relays for output actuation (AX5400PA) or 16-channel open-collector outputs (AX5400PB). When actuating external devices such as high voltage/current relays and switches, alarms, buzzers, and LEDs, the high power current sinks on each channel allows it to withstand up to 100mA. Both AX5400PA and AX5400PB are easily programmed using any language.

For AX5400PA, typically, the sixteen SPDT relays are ideal for applications such as device ON/OFF control or low power switching. All the relays are FORM C (Normally open, Normally closed and Common). The contacts are rated at 3A at $120V_{AC}$ or $24V_{DC}$ with resistive load.

For AX5400PB, all digital output channels are open-collector output. Have the capability of high-power current sinks up to 100mA for actuating external devices such as high voltage/high current relays, switches, alarms, buzzers, and LEDS.

You may configure the relay outputs by writing to registers. When the corresponding bit is in the low (0) state, the Normally Closed (NC) contact is connected inside the relay to the Common (CM) contact. When the corresponding bit is in high (1) state, the Normally Open (NO) contact is connected to the CM contact. All signals are connected in and out of the board via a 50-pin male mating connector.

1.1 Features

- 32-bit PCI Bus compatible D/O card with PnP features
- 16 channels digital output with opto-isolation
- 1000V_{DC} isolation
- Easy-to-install cabling via 50-pin male mating connector
- Bundles Windows 95/Windows NT driver and DOS DEMO program

For Version A Only

- Electromechanical relay outputs
- 3A contact rating at 120V_{AC} or 24V_{DC}
- +12V_{DC} internal or external power selection

For Version B Only

- Open-collector outputs
- Up to 24V outputs and 100mA current sinks
- 5 to 24 V_{DC} external power or +12V_{DC} internal power selection

1.2 Specifications

1.2.1 AX5400PA

- Relay Type: Single-pole double-throw
- Output Channels: 16
- Output Type: Form C Relay output
- External Power Supply Range: 12V_{DC}
- Contact Rating: 3A resistive load
- Contact Type: Gold overlay silver-nickel
- Contact Resistance: Max. 70mΩ
- Operating Time: 7ms
- Release Time: 4ms
- Life (mechanical): 20 million operations

1.2.2 AX5400PB

- Output Channels: 16
- Configuration: Open-collector
- External Power Supply Range: 5-24 V_{DC}
- Output Voltage: 5 to 24 V_{DC}
- Pull-up Resistor: 0Ω(default) or user-defined
- Current Sink: 100mA continuous
- Throughput Time: 0.1 ms max.

1.2.3 Interface Characteristic

- I/O Connector: 50-pin mating header

1.2.4 Power Requirements

- + 5V_{DC}: 0.5A max.
- +12V_{DC}: 0.8A max. (AX5400PA)

1.2.5 Physical/Environmental

- I/O Connector: 50-pin male mating connector
- Dimensions: 175 x 97 mm
- Weight: AX5400PA : 250 g
  AX5400PB : 110 g
- Operating Temperature Range: 0°C to 60°C
- Storage Temperature Range: -25°C to 85°C
- Relative Humidity: 0% to 90%, non-condensing

1.3 Applications

- Industrial ON/OFF control
- BCD interface driver
- Relay and LEDs ON/OFF control
- Process control

Chapter 2
Installation

2.1 Base I/O Port Address

AX5400PA/PB occupies only one I/O port space. The I/O port base address and even slot number are assigned by the PCI Plug & Play BIOS. From the device driver, user may acquire the base address and slot number where AX5400PA/PB is plugged into. For more detailed information, refer to Chapter 4 "Device Driver".

2.2 User Connections

All AX5400PA/PB digital output signals are built in a single connector (CN2). It provides convenience and is reasonably objective when connecting to AX751. The pin assignments are shown on the following pages.

2.2.1 AX5400PA

NAME	PIN	PIN	NAME
NO 0	50	49	CM 0
NC 0	48	47	CO 1
CM 1	46	45	NC 1
NO 2	44	43	CM 2
NC 2	42	41	NO 3
CM 3	40	39	NC 3
NO 4	38	37	CM 4
NC 4	36	35	NO 5
CM 5	34	33	NC 5
NO 6	32	31	CM 6
NC 6	30	29	NO 7
CM 7	28	27	NC 7
NO 8	26	25	CM 8
NC 8	24	23	NO 9
CM 9	22	21	NC 9
NO10	20	19	CM 10
NC10	18	17	NO 11
CM11	16	15	NC 11
NO12	14	13	CM 12
NC12	12	11	NO 13
CM13	10	9	NC 13
NO14	8	7	CM 14
NC14	6	5	NO 15
CM15	4	3	NC 15
GND	2	1	VEXT(+12V)

CN2

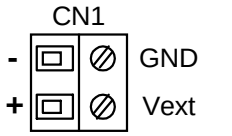
2.2.2 AX5400PB

NAME	PIN	PIN	NAME
D/O 0+	50	49	NC
D/O 0-	48	47	D/O 1+
NC	46	45	D/O 1-
D/O 2+	44	43	NC
D/O 2-	42	41	D/O 3+
NC	40	39	D/O 3-
D/O 4+	38	37	NC
D/O 4-	36	35	D/O 5+
NC	34	33	D/O 5-
D/O 6+	32	31	NC
D/O 6-	30	29	D/O 7+
NC	28	27	D/O 7-
D/O 8+	26	25	NC
D/O 8-	24	23	D/O 9+
NC	22	21	D/O 9-
D/O 10+	20	19	NC
D/O 10-	18	17	D/O 11+
NC	16	15	D/O 11-
D/O 12+	14	13	NC
D/O 12-	12	11	D/O 13+
NC	10	9	D/O 13-
D/O 14+	8	7	NC
D/O 14-	6	5	D/O 15+
NC	4	3	D/O 15-
External Power-	2	1	External Power +

CN2

2.2.3 External Power Connector

Connect the external power supply (5 to 24 V_{DC}) to connector CN1. The connector pin descriptions are given below:



external power connector

2.3 Hardware Installation

The AX5400PA/PB board is shipped with protective electrostatic cover. When unpacking, touch the board's electrostatically shielded packaging with the metal frame of your computer to discharge the accumulated static electricity prior to touching the board.

The following summarizes the installation procedures of AX5400PA/PB.

WARNING: *Turn OFF the PC and all accessories connected to the PC whenever you install or remove any peripheral board including the AX5400PA/PB card.*

2.4 Board Installation

1. Turn OFF the PC and the power connected to all accessories.
2. Unplug all power cords and cables from the rear of the PC.
3. Remove the PC's cover. (Refer to your PC Operation Guide if you are not skillful about it.)
4. Find an unused PCI expansion slot. Remove the blank PCI expansion slot cover and save the screw for later use.
5. Grab the upper edge of the AX5400PA/PB board. Align the AX5400PA/PB board's retaining bracket with the expansion slot rear panel, and straighten the board's gold finger with the expansion slot. Gently push the board into the slot.
6. Restore the screw in the PCI expansion slot retaining bracket.
7. Replace the PC's cover and connect the cables you detached in step 2.
8. Now turn ON the power of the PC and other peripheral devices. Proceed to Chapter 3 for software installation.

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Chapter 3
Register Structure & Format

3.1 AX5400PA/PB I/O Address Mapping

The AX5400PA/PB uses only 1 I/O address space as follows:

3.1.1 AX5400PA

Only base address +0 is used for 16-bit wide relay output register. This register is a read/write register for controlling relays. The controlling bit B0 through B15 corresponds to Relay1 through Relay16 onboard.

Base address + 0

LSB

Bit No.	7	6	5	4	3	2	1	0
Bit Name	R8	R7	R6	R5	R4	R3	R2	R1

Bit No.	15	14	13	12	11	10	9	8
Bit Name	R16	R15	R14	R13	R12	R11	R10	R9

MSB

R1 - R16 represent the status of RELAY1 - RELAY16

CONTROL BIT (R1 - R16)	CONTACT	
	CM - NO	CM - NC
0	Open	Short
1	Short	Open

3.1.2 AX5400PB

Only base address +0 is used for 16-bit opto-isolated output register. This register is a read/write register for digital output control.

Base address + 0

Bit	7	6	5	4	3	2	1	0
	D/O7	D/O6	D/O5	D/O4	D/O3	D/02	D/O1	D/O0
								LSB

Bit	15	14	13	12	11	10	9	8
	D/015	D/O14	D/O13	D/O12	D/O11	D/O10	D/O9	D/O8
	MSB							

D/O 0 through D/O15 represent digital output status for channel 0 through channel 15.

Chapter 4
Device Driver

Device driver is suitable for Plug & Play under DOS environment to get some information from PCI BIOS. This chapter describes in detail about how to install the device driver and use the its command to get base address, IRQ level, and slot number. Also testing programs are provided for reference.

After getting these information successfully, user can use the information to act as parameter for driver function. All operations within this section will not work if the device driver "AX5400.SYS" is not successfully installed.

4.1 How to Install the Device Driver

Before executing any application program (including the following examples), this device driver must be installed. To install the device driver, type

SETUP [SOURCE DRIVE] [TARGET DRIVE] [DIRECTORY]

This will copy device driver to desire driver and directory. And then add the following command line to your config.sys:

DEVICE = [PATH] AX5400.SYS

Example

If you insert this diskette in drive A: and want to copy the file into C:\AX5400. You must key in the following command line at the DOS prompt.

A:\SETUP A: C:\AX5400 [ENTER]

Then add the following line in your config.sys file.

DEVICE = C:\AX5400\AX5400.SYS

Reboot your computer.

If the AX5400 is plugged in your system, the following message will appear:

```
*  ********************************************************************  *
*              Copyright 1998 by AXIOMTEK Co., LTD                       *
*                              Ver 1.0                                   *
*              AX5400 DEVICE DRIVER INSTALLED                            *
*  ********************************************************************  *
```

Now AX5400 acts like a file. You can OPEN, CLOSE, WRITE (command), READ (base address, slot number) it via this device driver.

If there is no AX5400 installed in your system, the following message will appear:

AX5400 or PCI BIOS Not Found !!

Any OPEN to device driver will fail !

4.1.1 Using the Device Driver Command

The device driver is for user to get base address, and slot number of AX5400 plugged in your system.

Before accessing the device driver, open it as needed. After accessing the device driver, close it as also needed. To get any information (BASE ADDRESS, or SLOT NUMBER), first you must write a command to the device driver then the needed data can be read from the device driver.

There are two commands for user to obtain base address, and slot number. The number following the command indicates card number.

To get base address, you must write the command string "B?" to the device driver and then read a WORD (two bytes) from the device driver. This is the base address you need.

To acquire the slot number, you must write the command string "S?" to the device driver and then read a WORD (two bytes) from the device driver. This is the slot number you need.

NOTE: *The question mark "?" must be replaced with a card number. If base address returns to 0, it means all information retrieved by the card number are not available.*

Examples

1. Turbo C

```
* ********************************************************* *
* Example program for Turbo C language                      *
* To get BASE ADDRESS                                       *
*         SLOT NUMBER via device driver                     *
* Before executing this program, device driver must         *
* be installed successfully.                                *
* ********************************************************* *
```

```
#include <dos.h>
#include <stdio.h>
#include <string.h>
#include <conio.h>
#include <fcntl.h>
#include <io.h>

main()
{
   int      fd;
   int      base, busno;
   unsigned  int    i, j, dat;
   if ((fd=open("5400DRV",O_RDWR)) == -1 ) {
   printf("AX5400 OPEN FAIL !\n");
   exit(0);
}
else
   printf("OK\n");

write(fd,"B1",2);
read(fd, &base,sizeof(int));

write(fd,"S1",2);
read(fd,&busno,sizeof(int));

close(fd);
printf("BASE  ADDRESS :%X\n",base);
printf("SLOT  NUMBER :%X\n",busno);
if (base == 0) {
   printf("ERROR INFORMATION !\n");
```

```
   exit(0);
   }
}
```

2. Turbo PASCAL

```
* ********************************************************** *
* Example program for Turbo PASCAL language                  *
* To get BASE ADDRESS                                        *
* SLOT NUMBER via device driver                              *
* Before executing this program, device driver must          *
* be installed successfully                                  *
* ********************************************************** *

PROGRAM TP_DEMO(input,output);
uses dos,crt;
    var
    fdw:text;
    fdr :file of integer;
    addr,irqno,slotno:intrger;
begin
    clrscr;
    assign(fdw,'5400DRV');
    assign(fdr,'5400DRV');

rewrite(fdw);
writeln(fdw,'b1');
reset(fdr);
read(fdr,addr);

rewrite(fdw);
writeln(fdw,'s1');
reset(fdr);
read(fdr,slotno);
close(fdr );
writeln('BASE  ADDRESS : ',addr:10);
writeln('SLOT  NUMBER :',slotno:10);
if addr <> 0 then writeln('The information are correct');
END.
```

3. Qbasic 4.5

```
*  ********************************************************  *
*  Example program for QB45 language                        **
*  To get BASE ADDRESS                                      **
*  SLOT NUMBER via device driver                            **
*  Before executing this program, device driver must
*  be installed successfully.
*  ********************************************************  *
```

```
OPEN "5400DRV" FOR OUTPUT AS #1
OPEN "5400DRV" FOR BINARY AS #2
PRINT #1, "B1"
GET #2, 1, BL%
GET #2, 1, BH%
PRINT #1, "S1"
GET #2,  , S%
CLOSE #1
CLOSE #2
BL = BL%
BH = BH%
ADDR = BH * 256 + BL
PRINT "BASE ADDRESS: ", ADDR
PRINT "SLOT NUMBER :  ",S%
    IF ADDR <> 0 THEN PRINT " The information are correct"
```

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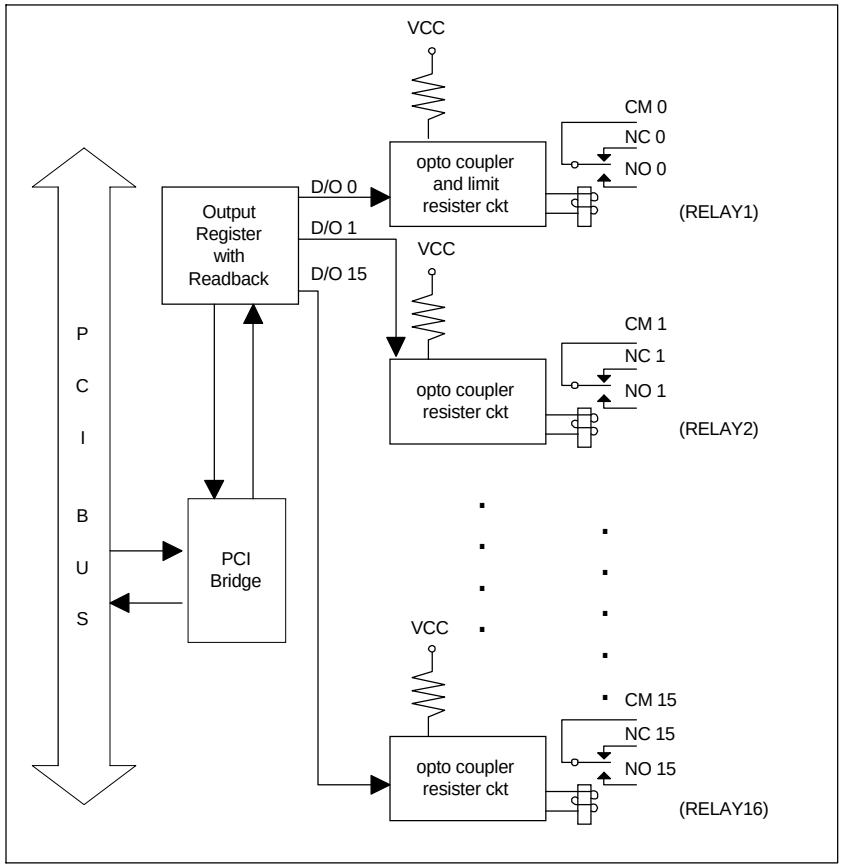
Appendix A
Block Diagram



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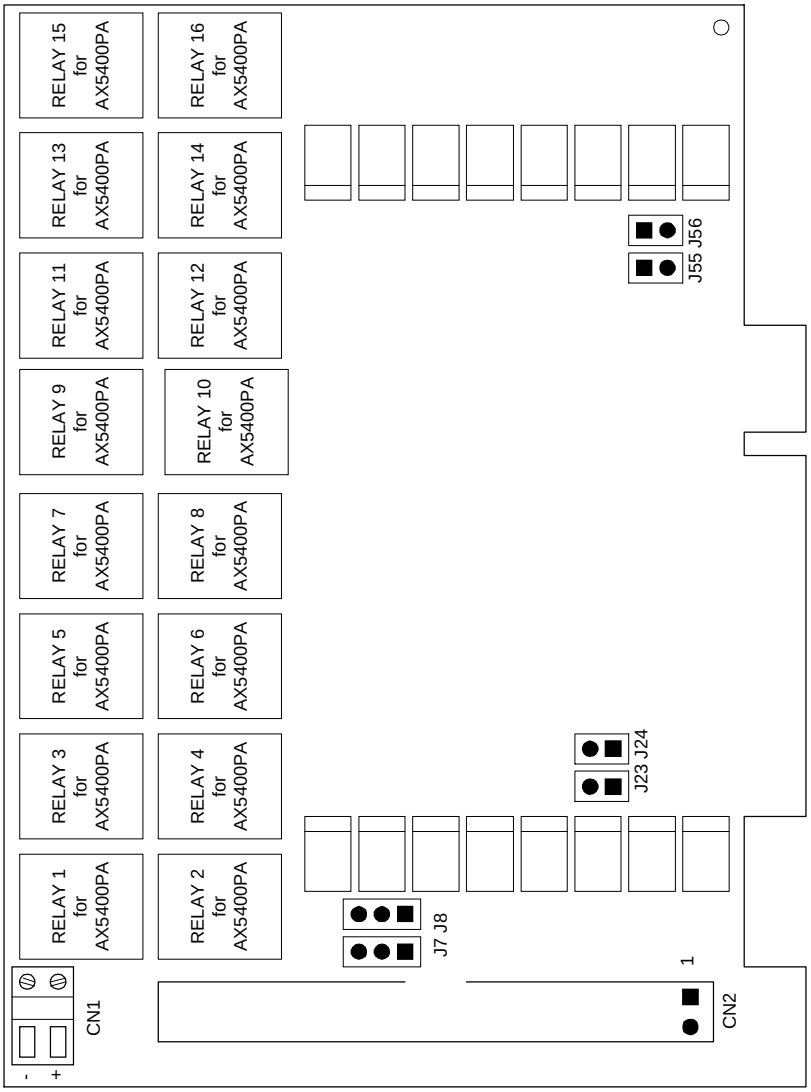
Appendix B
Location Diagram



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Appendix C
Functional Description

Relay Outputs

The sixteen onboard electromechanical relays are Form C relays. The contact rating is 3A at $120V_{AC}$ or $24V_{DC}$.

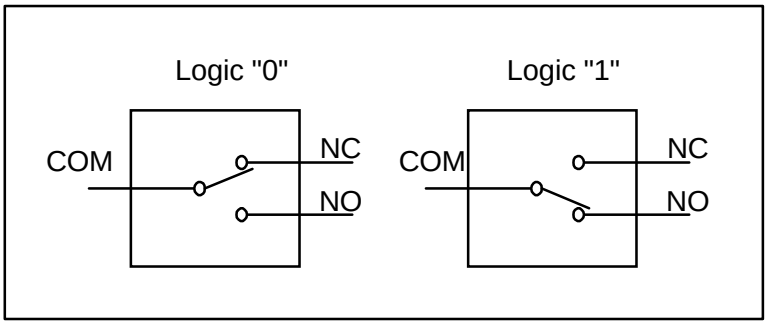
Form C Relay

Each Form C relay has three contacts: Normally Open (NO), Common (CM) and Normally Closed (NC). The CM post, located at the middle, can make contact with either NO post or NC post.

When the control bit at relay output register is low (0), the CM post and NC post make contact. If the control bit is high (1), the CM post and NO post make contact. The following table lists the contact arrangement for Form C relay.

CONTROL BIT (RO1 ~ RO16)	CONTACT	
	CM - NO	CM - NC
0	Open	Short
1	Short	Open

NOTE: *Upon power up or reset, the CM and NC contacts are connected.*



Open-Collector Output

Open-Collector output can be used to control another device having larger current (100mA/channel) or voltage levels (5 to 24VDC). Limit resistor for the AX5400 includes 16 independent 0Ω (default) resistor, that is one resistor for each output channel. The list of output channel and its corresponding limit resistor is given in below table.

The sink current calculation is

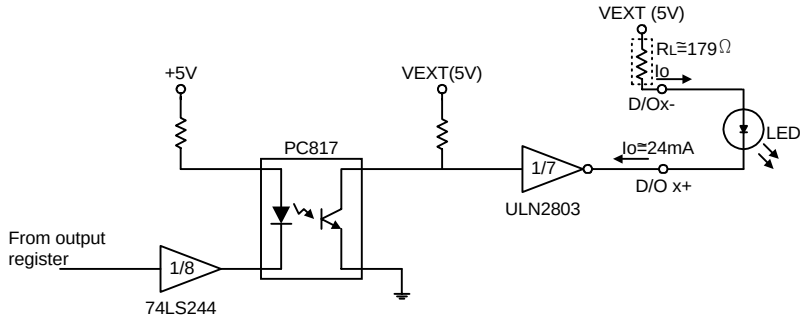
$$Io = \frac{VEXT - VCE_{(sat)}}{R_L}$$

There VEXT = external power supply voltage from 5 to 24VDC, $VCE_{(sat)}$ = transistor collector-emitter saturation voltage ≅ 0.7V and R_L = limit resistor.

Here is an example for calculating R_L, refer to below figure. Assume an LED's Load is 24mA and external power voltage is 5V then according to the above formula:

$$R_L = \frac{5V - 0.7V}{24mA} = 179\Omega$$

So install 179Ω resistor onto onboard reserved space.



NOTE:

D/Ox+	*D/O0+ through D/O15 + pin at CN2*
D/Ox-	*D/O0- through D/O15 pins at CN2*
R_L	*Onboard R1-R8 and R13-R20*
VEXT	*External power supply voltage connected to the AX5400 via pin1 and pin2 of CN2 or CN1*